Bridging the ERBE/ERBS and the CERES/Terra SW Climate Records

Takmeng Wong, Bruce Wielicki
Kathy Bush, Wenying Su, Dave Doelling, and Lou Smith
NASA Langley Research Center, Hampton, Virginia

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Problem

- The current top of atmosphere (TOA) broadband SW climate record from 1985 to 2005 is broken up into two segments (ERBE/ERBS: 1985 to 1999 and CERES/Terra: 2000 to present) due to the 5-month data gap between 10/1999 and 2/2000
- Without overlapping data, we can't tie these two SW climate segments together due to absolute calibration and time sampling differences between these two satellite missions

Objective

- Develop simple method to connect these two SW segments together

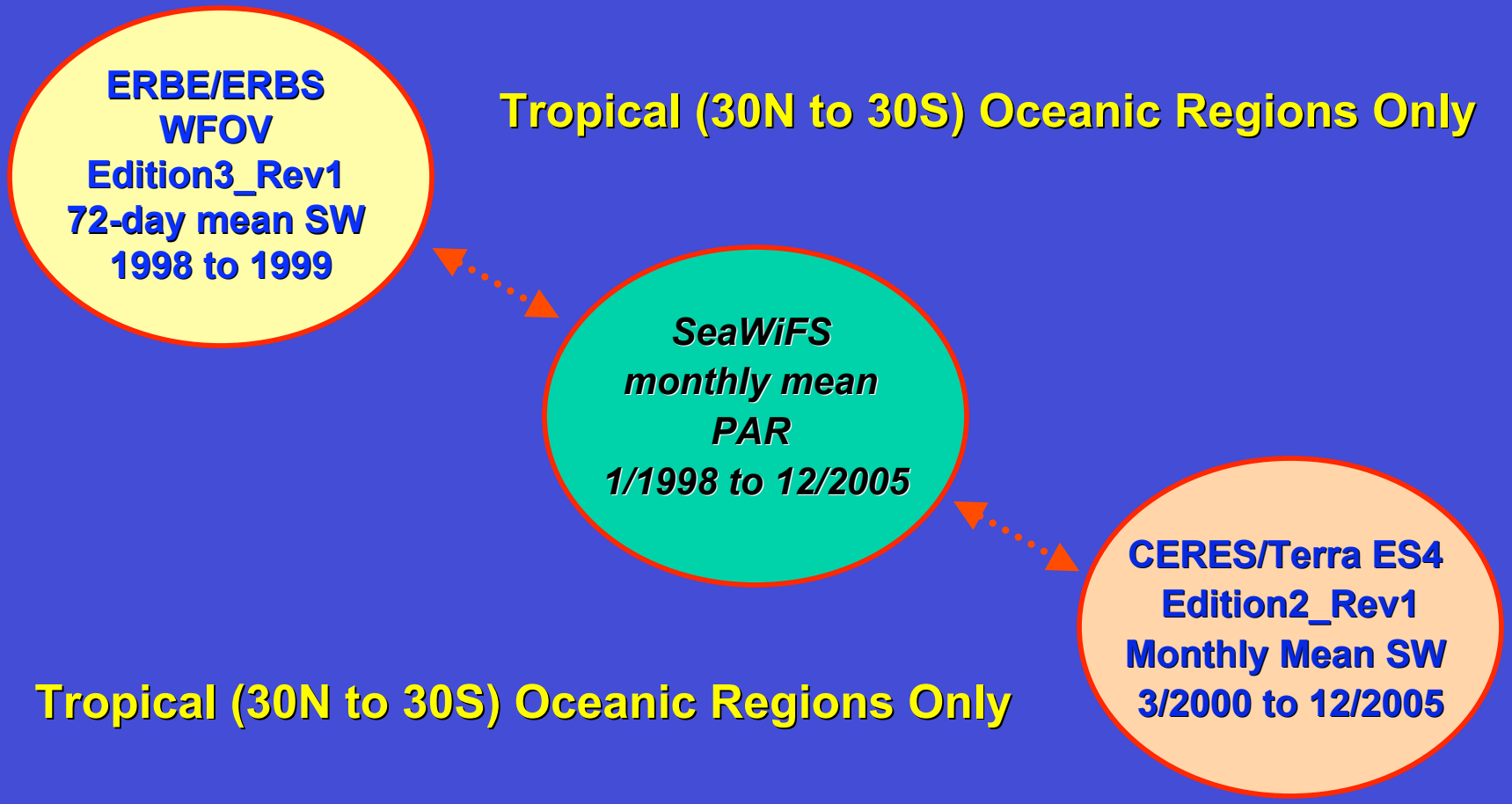
  1) Use ERBS data from 10/1999 to 8/2005

     - However, ERBS instrument anomaly on 10/5/1999 has not been corrected and data after 10/1999 is not currently useable for climate study. Works on correcting this instrument issue is currently underway

  2) Use other stable climate data source (i.e., SeaWiFS PAR data) to guide the transition from the ERBE/ERBS nonscanner record to the CERES/Terra record

     - Loeb et al., J. Climate, Feb 2007 found excellent consistency between monthly mean CERES/Terra TOA SW flux anomaly and monthly mean SeaWiFS PAR anomaly time series

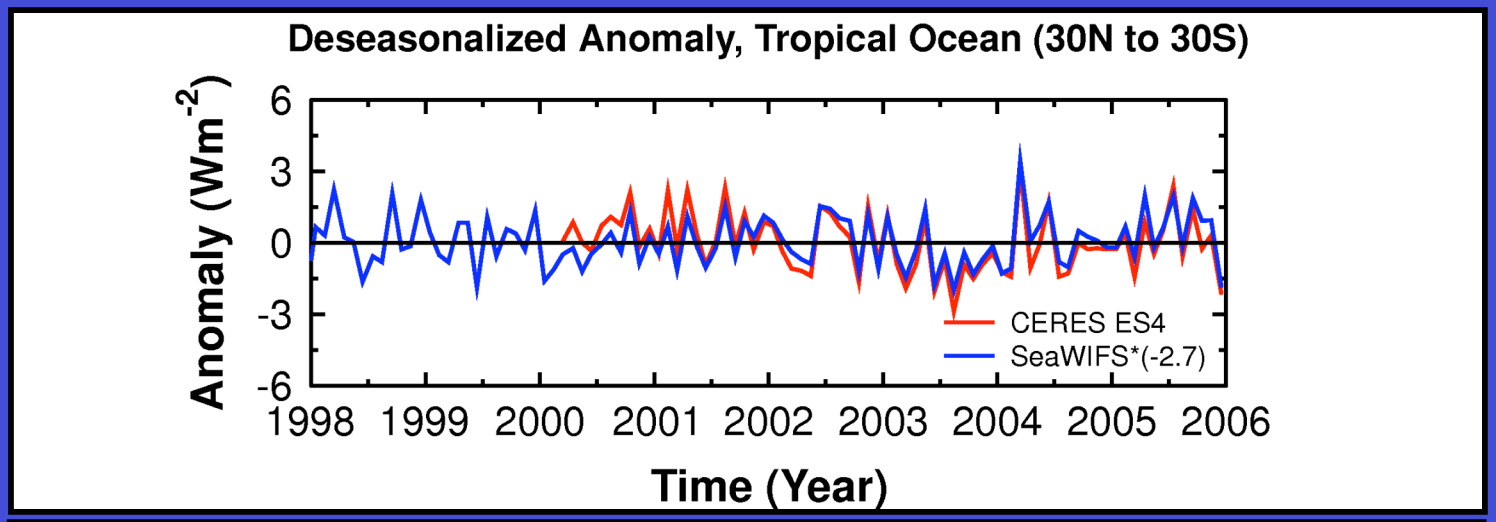
Datasets

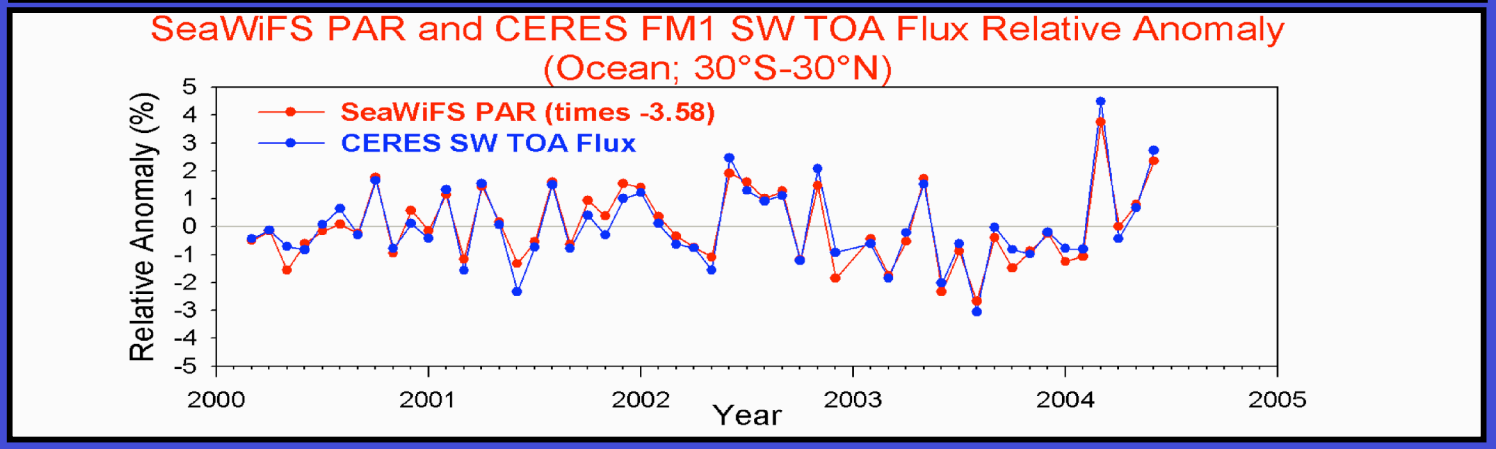

ERBE/ERBS
WFOV
Edition3_Rev1
72-day mean SW
1998 to 1999
Tropical (30N to 30S) Oceanic Regions Only
SeaWiFS
monthly mean
PAR
1/1998 to 12/2005
CERES/Terra ES4
Edition2_Rev1
Monthly Mean SW
3/2000 to 12/2005
Tropical (30N to 30S) Oceanic Regions Only

Methodology

- Calculating time series of deseasonalized anomaly of TOA SW flux and SeaWiFS PAR using 3/2000 to 2/2005 as baseline climatology
- Extend the SeaWiFS PAR deseasonalized anomaly time series back in time to 1/1998 using the same SeaWiFS PAR baseline climatology
- In order to do time matching between CERES and ERBS data, we need to take a 5-month running mean (~150 days) for the CERES (and SeaWiFS) and match that to the 144-day mean ERBS nonscanner data
- Calculate the ERBS nonscanner anomaly using CERES baseline climatology and renormalized them according to the SeaWiFS anomaly during the same period

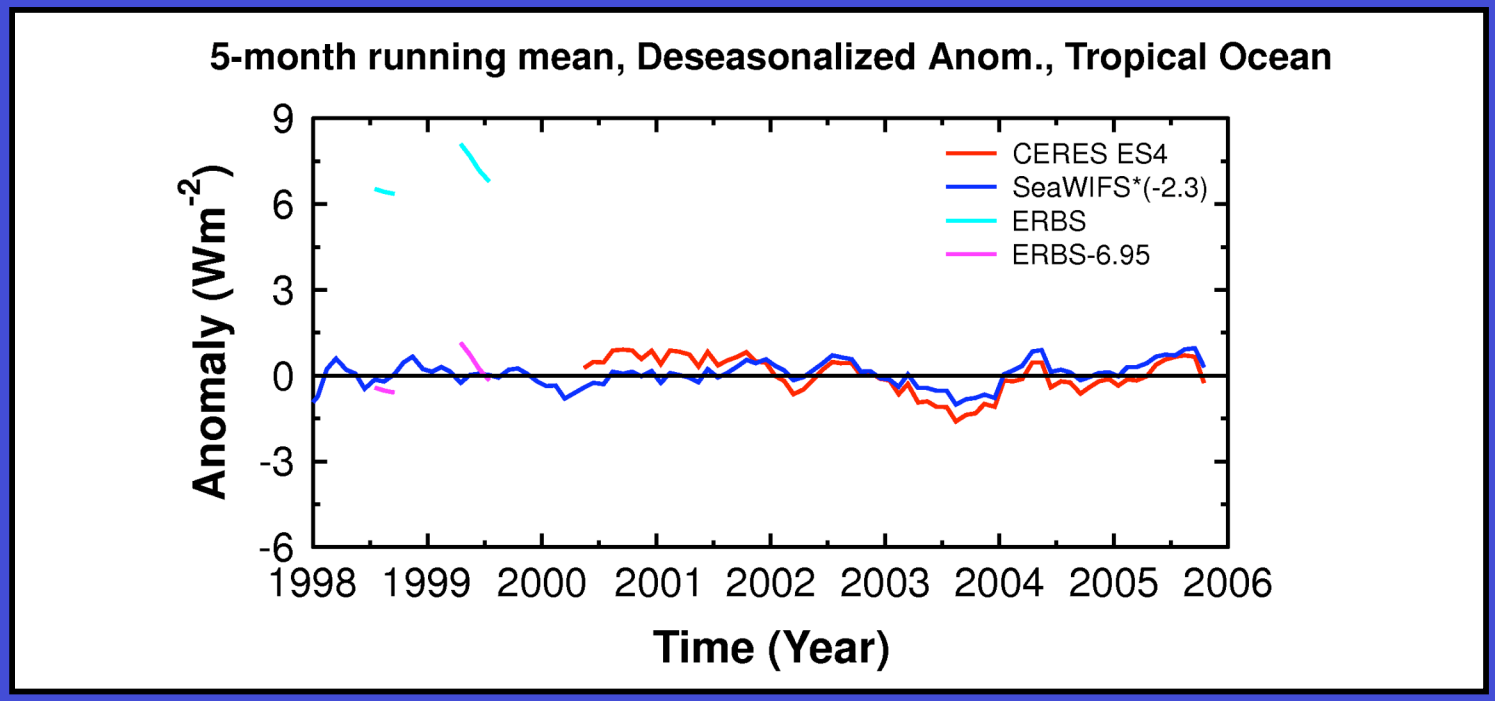
Deseasonalized Monthly Anomaly





- Excellent result for deseasonalized anomaly between CERES/Terra ES-4 SW and SeaWiFS PAR (similar to those of Loeb et al., 2007)

Deseasonalized 5-month running mean Anom.



- ERBE/ERBS and CERES/Terra SW difference, determined using SeaWiFS data, is about ***6.95 Wm^{-2}*** over the tropical oceanic regions
- This difference is at the edge of the combined SW uncertainty of the two missions (2-sigma of 2% for CERES and 5% for ERBE)

Sources of the ERBS-CERES Difference

Total Differences = **Instantaneous Difference** +
Temporal Sampling Difference +
Residual Terms

	ERBS Sc	ERBS NS	ScaRaB 1	CERES /TRMM	ScaRaB 2	CERES FM-1	CERES FM-2	CERES FM-3	CERES FM-4
ERBS Sc	-	**-5.4**	-4.5	-1.8	-5.2	-2.0	-1.7	-1.1	-1.2
ERBS NS	**0.3**	-	**0.9**	**3.6**	-0.2	3.4	3.7	4.3	4.2
ScaRaB 1	0.5	**0.4**	-	2.7	-0.7	2.5	2.8	3.4	3.3
CERES/ TRMM	0.9	**0.9**	1.0	-	**-3.4**	**-0.2**	0.1	0.9	0.6
ScaRaB 2	1.7	1.7	1.7	**1.4**	-	3.2	3.5	4.1	4.0
CERES FM-1	1.2	1.1	1.2	**0.7**	1.6	-	**0.3**	0.9	**0.8**
CERES FM-2	1.3	1.2	1.3	0.9	1.6	**0.5**	-	0.6	0.5
CERES FM-3	1.2	1.2	1.2	0.7	1.6	0.2	0.5	-	**-0.1**
CERES FM-4	1.2	1.1	1.2	0.7	1.6	**0.1**	0.5	**0.2**	-

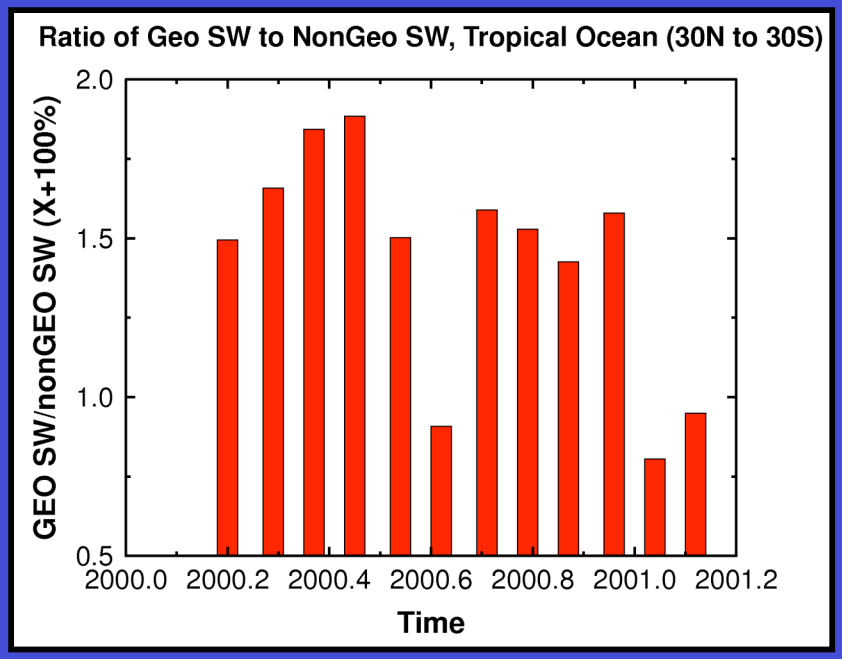
- SW traceability study from Smith et al. (2006) + additional SW dome correction (Wong et al., 2006)
- Instantaneous differences can be estimated to be on the order of ***4.9 Wm^{-2}*** or about ***71%*** of the total ERBS-CERES differences

Sources of the ERBS-CERES Difference

Total Differences = Instantaneous Difference +

Temporal Sampling Difference +

Residual Terms



- Diurnal sampling correction using both CERES/Terra SRBAVG GEO and Non-GEO dataset
- Satellite temporal sampling differences can be estimated to be on the order of ***1.3 Wm^{-2}*** or ***19%*** of the total ERBS-CERES differences.

Summary

- CERES/Terra ES-4 SW deseasonalized monthly anomaly shows excellent agreement with SeaWiFS deseasonalized monthly PAR anomaly
- Using SeaWiFS deseasonalized 5-month running mean anomaly as a transfer guide, ***ERBS-CERES difference is determined to be 6.95 Wm^{-2} over tropical oceanic region***
- ***~71%*** of this difference can be accounted for by the estimated instantaneous differences between ERBS and CERES
- ***~19%*** of this differences is due to the satellite temporal sampling differences between the two satellite missions
- Additional work is needed to determine the causes of the residual differences ***(~10%*** of the total differences)
- Future work will also be needed for combining the two long-term LW records from ERBS to CERES